SYNTAX ZX80®

A PUBLICATION OF THE HARVARD GROUP

NEW NEW 8K ROM PLUS PRINTER

Last month we announced a new 8K ROM chip from Sinclair for about the first of the year. Now Sinclair is revamping that chip. The new chip will support the low cost printer Sinclair plans to introduce next year. Sinclair expects to retain all previously announced functions and price. Redesigning will delay production a few weeks.

AUTHORIZED SOFTWARE

Image Computer Products of Northbrook, IL, is the authorized ZX80 software producer. They are a division of The Image Producers, Inc., an advertising and marketing agency. Besides ZX80 software, Image writes for Apple II, TRS-80, Sorcerer and Atari microcomputers.

Dick Schultz, sales manager, says Image offers primarily game cassettes and some utility and math tapes. A cassette contains 2 to 4 programs and comes with an instruction manual containing listings and flowcharts for $6.95.

In cooperation with Sinclair Research, Image now offers a ZX80 Computer Learning Lab, a system of self-paced computer programs and workbook lessons, designed for an interactive learning experience. New computer owners can learn problem-solving and programming in a hands-on approach.

Both the Learning Lab and a complete ZX80 are available from Sinclair by mail for $249. Image sells the Learning Lab alone for $49.95—see catalog for details.

SOFTWARE CATALOGS AVAILABLE

Software catalogs from Image Computer Products are hot off the presses and available to ZX80 and MicroAce owners.

New ZX80 owners will find the catalog packed with their machine. Owners who bought their ZX80's before the catalog was printed will receive them in the mail from Sinclair Research. MicroAce owners can get a copy by writing to Image Computer Products, 615 Academy Dr., Northbrook, IL, 60062, or calling 312/564-5060.

SINCLAIR SHIPMENTS PICK UP

Sinclair caught up with their ZX80 shipping schedule in November because production rates are up to meet the demand. What does this mean to ZX80 owners? If you must return your ZX80 for replacement under warranty, expect to receive your new machine much faster than you old one. According to Nigel Searle of Sinclair, shipments now turn around on a one day schedule, so your new ZX80 will go right out the door.

8K ROM PROGRAMS HERE!!

Next month we'll bring you tested and debugged programs to run with the new 8K ROM. Our technical staff has the only prototype 8K ROM in the U.S. and we're working on programs so you will be able to use your new ROM immediately. We're especially impressed by the graphics capability and the PLOT-DRAW-PRINT sequence.

NEW MODEM

MicroPeripheral Corp. will introduce a modem for ZX80 and MicroAce machines by 1 January 1981, enabling you to connect to other computers by telephone. The computer turns its electrical signals into tones which are carried through the phone lines.

Unlike most modems, this one will plug right into the telephone jack, so it needs no acoustic coupler. Direct connection gives you clearer signal reception and transmission.

Acoustic couplers attach to the telephone handset and transmit sound. Unfortunately, the modem will transmit any sound it hears, including background noise.

MicroPeripheral's modem works at 300 baud (30 characters per second) in both answer and originate modes. An interface decodes the bus on the chassis rear, eliminating the need for an RS232 adapter.

Perhaps the most exciting use for this new accessory, according to Don Stoner of MicroPeripheral, is becoming part of the giant nation-wide computer networks such as The SOURCE or Micronet. You can access government data bases like the National Health Library in Bethesda, or free public bulletin boards. These systems are compatible between several kinds of computers, so you can communicate with a vast number of people and machines. For a list of regional systems, write to:

Donald Stoner
Customer Service
MicroPeripheral Corp.
Box 529
Mercer Island, WA 98040

(More information about The SOURCE and Micronet in a later issue.)

At press time, Sinclair has 16K RAMs in production, available in January after FCC approval.

EXTENDED ZX80 SERVICE CONTRACTS

Sinclair now offers extended service contracts to ZX80 owners. $25 per year will cover all parts and labor and return shipment of the unit. (You ship the machine prepaid to Sinclair and they pay the return postage.) For further information, contact Sinclair Research Ltd, 50 Staniford St., Boston, MA, 02114.

OUR POLICY ON CONTRIBUTED MATERIAL

SNYTAX ZX80 invites you to express opinions related to the ZX80 and the newsletter. We will print, as space allows, letters discussing items of general interest. Of course, we reserve the right to edit letters to a suitable length and to refuse publication of any material.

We welcome program listings for all levels of expertise. Programs can be for any fun or useful purpose. We will test run each one before publishing it, but we will not debug programs; please send only workable listings.

In return for your listing, we will pay you a token fee of $2.00 per program we use. This payment gives us the nonexclusive right to use that program in any form, world-wide. This means you can still use it, sell it, or give it away, and so can we.

We will consider submissions of news and hardware or software reviews. Please keep articles short (50-100 words). Again, we reserve the right to edit accepted articles to a suitable length. We will pay 7 cents per 6 characters, including spaces and punctuation, for accepted articles.

If you want us to return your original program listing or article, please include a self-addressed, stamped envelope. Otherwise, we cannot return submitted material.

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MULTIPLICATION EXERCISE

This is a program I wrote to help my daughter practice her multiplication. It asks for the multiplier (any number up to 3276) and then presents 5 problems, randomly choosing a number from 1 to 10. You get two tries to answer correctly. After the second try, the machine gives you the right answer with the next problem. At the end, it displays the number correct and then you can re-execute the program. This program uses 1K memory, so you can add more descriptive information as memory becomes available.

```
 10 PRINT "HI.  WHAT IS YOUR
NAME?"
 20 INPUT A$
 30 CLS
 40 PRINT "OK, ";A$;"  ENTER
MULTIPLIER."
 50 INPUT A
 60 LET B=0
 70 DIM X(5)
 80 FOR J=1 TO 5
 90 LET C=RND(100)
100 IF C>10 THEN LET C=C/10
110 LET X(J-1)=C
120 GO SUB 500
130 INPUT E
140 FOR L=1 TO 2
150 PRINT E
160 PRINT "THAT IS ";
170 IF NOT E=A*C THEN PRINT "IN
";
180 PRINT "CORRECT"
190 IF E=A*C THEN GO TO 250
200 IF L=2 THEN GO TO 260
210 PRINT "PLEASE TRY AGAIN."
220 INPUT E
230 GO SUB 500
240 NEXT L
250 LET B=B+1
260 PRINT "PRESS (NEWLINE) TO C
ONTINUE"
270 INPUT B$
280 NEXT J
285 LET J=J-1
290 GO SUB 500
300 PRINT A*X(4)
310 IF B>1 THEN GO TO 340
320 PRINT "BETTER TRY AGAIN, ";
330 GO TO 380
340 IF B 5 THEN GO TO 370
350 PRINT "EXCELLENT, ";
360 GO TO 380
370 PRINT "NOT BAD, ";
380 PRINT A$
390 PRINT "YOU GOT ";B;" CORREC
T."
400 INPUT B$
410 CLS
420 PRINT "WANT TO TRY AGAIN?"
430 INPUT B$
440 IF CODE(B$)=62 THEN GO TO 3
0
450 CLS
460 PRINT "OK, ";A$;".  THANKS
FOR"
470 PRINT "PLAYING WITH ME."
480 PRINT "SEE YOU NEXT TIME."
490 STOP
500 CLS
510 PRINT "MULTIPLY BY ";A
520 FOR K=1 to J
530 PRINT X(K-1);" X ";A;" = ";
540 IF NOT K=J THEN PRINT X(K-1
)*A
550 NEXT K
560 RETURN
```
SYNTACTIC SUM = -5144

Pete Cone, Davenport, IA

Image Computer Products wants people to write ZX80 programs. For author's guide, contact Al Baker, program director at Image.

MAKE-DO CONNECTORS

At SYNTAX we use a Radio Shack connector. Their solderless edge-card, 40-pin connector (#276-1558) usually picks up all the contacts we need. We also use 40-conductor, insulation displacement, ribbon cable and mount the connector with a metal-jawed vise. We open the connector ends with a small burr in a hobby grinder. (Put a piece of circuit board between the contacts to prevent damage while cutting end slots.) We terminate the cable with an experimenter board so we can simply plug into the contact strips with wire jumpers to the prototype board.

CASSETTE EAVESDROPPER

Use this simple circuit to listen to your programs as they save and load or to search for programs on tape without pulling the earphone cord and adjusting the volume control each time.

The circuit consists of one 3.5 mm (0.125 inch) phone plug wired to a 3.5 mm miniature phone jack with another 3.5 mm phone jack wired in parallel through a 1KΩ resistor. Build it into any type of holder (a Radio Shack project box is neat and inexpensive), although a metal housing helps avoid TV interference. Using a small coaxial cable (rather than separate conductors) for the wire to the cassette plug further avoids interference.

Once you build the device, plug the phone plug into the cassette earphone jack, an earphone into the jack with the resistor, and the ZX80 into the other jack. Now you can listen to your tapes through the earphone with the volume set to maximum, even if the ZX80 is listening too.

TIP RING
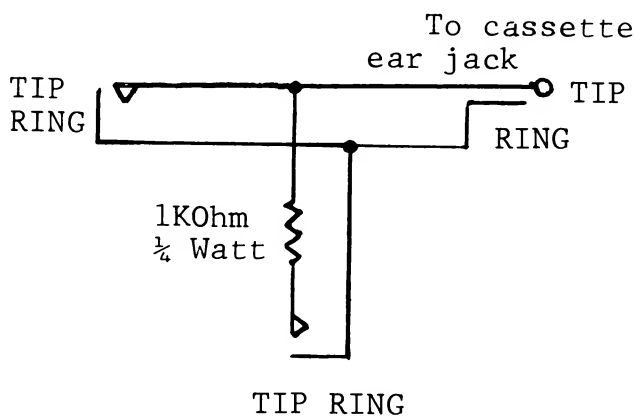
Paul Holzchuher called to tell a strange story. His ZX80 worked fine on the dining room table, but on an aluminum table it wouldn't load prerecorded or newly recorded tapes. Raising it off the table with books was no help. A wooden table cured the problem. When you have trouble reloading programs, move your ZX80 to a non-conducting surface.

SEASON'S GREETINGS

Here is our personalized holiday greeting to you, courtesy of your ZX80 or MicroAce. With a little clever substitution in lines 450-640, you can adapt this listing to produce your own video Christmas card.

```
 49 GO TO 100
 50 FOR I=1 to LM
 60 PRINT " ";
 70 NEXT I
 80 RETURN
 99 STOP
100 FOR N=2 TO 16
110 LET M=2*(N/2)-1
120 LET LM=16-M
130 GO SUB 50
140 FOR J=16-M+1 to 16+M-1
150 LET Y=51+RND(M)
160 IF Y=52 THEN LET X=Y
170 IF Y>52 THEN LET X=Y-51
180 IF Y>62 THEN LET X=222
190 PRINT CHR$(X);
200 NEXT J
210 PRINT " "
220 NEXT N
400 LET LM=15
410 GO SUB 50
420 PRINT "U"
450 LET A$="Z"
465 LET D$="TAX"
480 LET K$="O"
485 LET N$=" "
500 LET LM=9
510 GO SUB 50
520 PRINT "HAPPY HOLIDAYS"
530 LET LM=12
540 GO SUB 50
560 PRINT "A";A$;N$;"K";K$;N$;"
E";K$
580 LET LM=13
590 GO SUB 50
600 PRINT "SYN";D$
620 LET LM=14
630 GO SUB 50
640 PRINT A$;"X";5*4**2
SYNTACTIC SUM = -27631
```

COMPU-CALENDAR

This three-part program returns correct day name, changes Gregorian dates to corresponding Julian day numbers, and computes total days between any two dates from Jan. 1 AD to Feb. 2300.

To use, type the month number (NL), day number (NL), and four-digit year (NL). ZX80 returns the correct day name, followed by a prompt. Type J (NL) and it prints the equivalent Julian day number. (Julian days begin at GMT noon on each day and count days from noon, January 1, 4713 BC.)

You can also calculate the number of days between two dates. Enter the earlier one first, using J (NL) to compute JD, then enter the second date but just hit (NL) instead of J (NL) to request total days between the 2 dates.

Note that the ZX80 correctly reads out JD numbers in millions, thousand and units, but blanks leading zeros in each group. When reporting total days, sometimes the program displays thousands of days as 1000 too high, followed by negative hundreds; just add them. For example: A read out of 2,-825 means total days = 1,175.

To exit the program, enter numeral zero (NL) as the month.

Otis Imboden, Washington, D.C.

Note: This program takes leap years into account, but as written cannot display them. —AZ

```
10 PRINT "COMPU-CAL"
15 CLEAR
20 PRINT "ENTER MO/DY/YEAR"
30 INPUT M
40 IF M=0 THEN STOP
50 INPUT D
55 INPUT Y
57 CLS
62 PRINT "YOUR DATE(";M;"/";D;
"/";Y;")=";
68 IF Y<1900 OR (Y=1900 AND M<
3) THEN LET D=D+1
69 IF Y<1800 OR (Y=1800 and M<
3) THEN LET D=D+1
70 IF M>2 THEN GO TO 90
80 LET Y=Y-1
85 LET M=M+13
87 GO TO 91
90 LET M=M+1
91 IF Y>2199 THEN LET D=D-1
93 IF Y>2099 THEN LET D=D-1
100 LET A=Y*3+7200
110 LET B=(Y*6)+(M*3)+98
120 LET C=(Y*5)+((M*6)/10)
130 LET D=D+(Y/4)+C+2
135 LET L=1+A/10000
136 LET A=A-(10000*(A/10000))
145 LET T=(A/10)+(B/100)+(D/100
0)
147 LET U=(100*(A-10*(A/10)))+(
10*(B-(100*(B/100))))+(D-1000*(D/
1000)))
148 LET T=T+U/1000
149 LET U=U-(1000*(U/1000))
150 LET Z=2+L+(T*-1)+U
155 LET Z=Z-(7*(Z/7))
157 IF Z<0 THEN LET Z=Z+7
158 GO SUB (Z*2)+160
159 GO TO 179
160 PRINT "SATUR";
161 RETURN
162 PRINT "SUN";
163 RETURN
164 PRINT "MON";
165 RETURN
166 PRINT "TUES";
167 RETURN
168 PRINT "WEDNES";
169 RETURN
170 PRINT "THURS";
171 RETURN
172 PRINT "FRI";
173 RETURN
174 GO TO 160
179 PRINT "DAY"
181 INPUT J$
182 IF J$="J" THEN GO TO 195
186 IF T-S<1 THEN GO TO 188
187 PRINT T-S;",";
188 PRINT U-W;" TOTAL DAYS"
190 GO TO 15
195 LET S=T
197 LET W=U
199 PRINT "JD=";L;".";T;",";U
210 GO TO 20
```
SYNTACTIC SUM = 22279

COMPARISON BETWEEN THE SINCLAIR ZX80 AND THE TRS-80 COLOR COMPUTER

ITEM	SINCLAIR ZX80	TRS-80 COLOR	SINCLAIR W/8K ROM
Price	$200	$400	$240
Max size of array	255	mem-limit	mem-limit
Max # of dimensions	1	1	mem-limit
Digits of accuracy	5 integer	9 floating	9.5 floating
Range of numbers	+/- 32767	1E-38 to 1E+38	9E-44 to 1.1E+43
Max string length	mem-limit	255	mem-limit
Max size str array	no string arrays	mem-limit	mem-limit
# of str dimensions	no string arrays	1	mem-limit
# unique var names	mem-limit	936	mem-limit
# unique str names	26	936	26
Range of state #'s	1-9999	0-63999	1-9999
Comma spacing	8	16	16
# of comma fields	4	2	2
Str. data req "'s	no data stmnt	no	yes
Filenames (length)	no	8	mem-limit
Display size	25 x 32	16 x 32	22 x 32
Editor type	1 line scrn & list	none	1 line scrn & list
Point of E switch	none	1 E-3 & 1 E+9	1 E-6 & 1 E+13
Use DEG/RAD/GRAD	none	RAD	RAD
Printer available?	no	yes	yes
Graphics resolution	none	64 x 32	64 x 44
Graphics origin	none	top left	bottom left
Colors available?	no	8	no
Joysticks avail?	no	yes	no
String concat	no	yes(+)	yes (+)
Cassette data I/O	no	yes	no
Mult stmnts/line	no	yes (:)	no
Uses ASCII	no	yes	no
Display w/o stop	no	yes	yes
Kbd readable	no	yes	yes
Protectable memory	no	yes	yes
Internal clock	p&p	no	p&p
ARE THE FOLLOWING FUNCTIONS INCLUDED?			
** or uparrow	X		X
ABS & INT & SGN	ABS only	X	X
NOT & AND & OR	X	X	X
SIN & COS		SIN only	X
FRE/FREE/MEM		X	X
VAL		X	X
LEN		X	X
SEG$/MID$ or equiv.		X	X
LEFT$ & RIGHT$		X	X
TAB		X	X
EOF		X	
TAN & ATN			X
ASN & ACS			X
LOG/LN			LN
EXP & SQR/SQRT			X
PI			X
POINT		X	
JOYSTK		X	

ITEM	SINCLAIR ZX80	TRS-80 COLOR	SINCLAIR W/8K ROM
ARE THE FOLLOWING STATEMENTS SUPPORTED?			
RANDOMIZE	X	NOT NEEDED	X
FOR with STEP		X	X
GET/INKEY$		X	X
PRINT AT		X	X
READ & DATA		X	X
RESTORE		X	X
PLOT/SET		X	X
UNPLOT/RESET		X	X
INPUT#/PRINT#		X	
OPEN		X	
CLOSE		X	
AUDIO ON/OFF		X	
ON...GOSUB		X	
ON...GOTO		X	
IF...THEN...ELSE		X	
END		X	
SOUND (make noise)		X	
PRINT USING/TO			X
WAIT (time delay)			X
DRAW/LINE			X
UNDRAW/UNLINE			X
PAUSE			X
SCROLL			X
ARE THE FOLLOWING COMMANDS SUPPORTED?			
LLIST		X	
SKIPF		X	
MOTOR ON/OFF		X	

ALL THREE MACHINES USE:
* String comparisons in an IF statement
* Immediate mode
* Dynamic DIM
* Double quotes (") for literal strings
* An output line width of 32 characters
* Operators +, -, *, and /
* LET, PRINT, INPUT, GOTO, IF...THEN, GOSUB, RETURN, FOR...NEXT, STOP, CLEAR/CLR, CLS, and REM statements
* PEEK, POKE, USR/EXEC, ASC/CODE, CHR$, and STR$ functions
* RUN, CONTINUE, LIST, NEW, SAVE, and LOAD commands

NONE OF THE MACHINES USE:
* MAT statements
* High speed cassette search
* Available floppy disks

NOTE: A / between choices indicates either fulfills category, while & requires both.

NOTE: P&P indicates that a simple PEEK and POKE operation performs a function not supported in system.

● Range of numbers—greatest and smallest no. system can express.
● Output line width—greatest no. of characters on one output display line.
● Comma spacing—width of comma print fields.
● # of comma fields—no. of comma print fields across one display line.
● Str data req "'s—do strings in data statements require quotes?
● Editor type—what kind of editor does system use? (1 line scrn means a single line screen editor, list means listing is on screen while editing.)
● Point of E switch—no. at which system switches to display in scientific notation.
● Use DEG/RAD/GRAD—how does system measure angles?
● Graphics resolution—using system plot commands (4K & program can plot 64 x 48 from top left).

● String concat—can system append one string to another?
● Cassette data I/O—can system store data (as opposed to programs) on cassette tape?
● Uses ASCII—does system use American Standard Code for Information Interchange?
● Display w/o stop—can system display something and continue without any user interaction?
● Display size—height and width of display in characters.
● Kbd readable—can system read keyboard without stopping?
● Protectable memory—can a section of memory be protected so that machine language programs may be stored there?
● USR/EXEC—equivalent functions, transfer control to a machine language program.
● POINT—returns whether or not a certain graphics point is lit on the screen.
● FRE/FREE/MEM—return amount of memory not used by program.

● RANDOMIZE—reseeds random number generator.
● PRINT USING/TO—print no. according to a specific format.
● FOR with STEP—extended form of a FOR...NEXT statement to specify an increment.
● END—signals end of program.
● BEEP—tells system to sound a beeper to notify user.
● SOUND—tells the system to make one of 255 sounds.
● GET/INKEY$—read keyboard without stopping.
● PRINT AT—prints information at a certain screen position.
● WAIT—pause for a certain programmable length of time.
● READ & DATA—reads nos. or strings from list of information after DATA statement and puts it in variables.
● RESTORE—resets data list so same data may be read in again.
● DRAW—draws a line on screen.
● PLOT/SET—turns on screen pixel.
● UNDRAW—opposite of DRAW.
● UNPLOT/RESET -opposite of PLOT.
● INPUT #—reloads all variables in memory from tape.
● PRINT #—stores all variables in memory on tape.
● PAUSE—causes program to stop for a moment and display output.
● SCROLL—causes all lines on screen to move up one.

● SAVE/CSAVE—stores program on cassette tape.
● LOAD/CLOAD—reloads program from cassette tape.
● SKIPF—skips a file on tape.

● Dynamic DIM—array sizing using a variable: DIM A(G).

Syntactic Sums are an easy way to check your program typing for errors. Look for our Syntactic Sum program in SYNTAX, Feb. 81.

The ZX80's black-on-white video output is somewhat hard to read. Most computers have a black background with white letters. There is a simple way to reverse the ZX80 video output.

The video input to the RF modulator comes from an exclusive OR gate. One input to this gate is the sync signal and the other is the data. The data input comes from pin 7 of IC9, a 74LS165. This is the $\bar{Q}$ output of the parallel to serial converter. On the bottom side of the PC board near IC9 are 3 points marked A, B, and C. A goes to the exclusive OR gate, B to the Q output (pin 9) of IC9, and C goes to the $\bar{Q}$ (inverted) output (pin 7). Presently A is connected to C. To reverse the output, break the connection between A and C and make a new one between A and B. Or you could install a switch to switch between the 2 different outputs.

Thanks for your magazine. It should be a big help to all ZX80 owners in the future.

Brent Dix, Cedar City, UT

Here is a TAB subroutine listing. It causes the display to tab to any column, 1-32 left to right. Just give COLTAB a value corresponding to the desired column number and insert a subroutine call in your program.

```
 900 GO TO 2000
 999 REM TAB
1000 IF COLTAB>32 THEN RETURN
1005 LET ITAB=PEEK(16420)-(34-CO
LTAB)
1010 IF PEEK(16420)<2 THEN LET I
TAB=33-(34-COLTAB)
1015 IF ITAB<1 THEN RETURN
1020 LET JTAB=1
1030 PRINT " " ;
1040 IF JTAB=ITAB THEN RETURN
1050 LET JTAB=JTAB+1
1055 GO TO 1030
1060 REM AS CONTINUING PART OF
1061 REM "PRINT ;" "GO SUB 1000"
1062 REM CAUSES TAB TO COLUMN
1063 REM IN "COLTAB" (1-32,
1064 REM LEFT TO RIGHT)
1065 REM "COLTAB NOT CLEARED.
1066 REM "COLTAB" MUST ALLOW
1067 REM SPACE FOR ALL
1068 REM INFORMATION PRINTED.
2000 STOP
```

(Listing appears exactly as on a TV screen. In line 1005, COLTAB is one word, as is ITAB in line 1010.--AZ)

To add another tab setting, add a ; to the end of your first print command, then assign another value to COLTAB. Insert another GO SUB and PRINT statement and the display will print in two columns.

William Herron, San Diego, CA

I have an engineering background but am a raw beginner when it comes to computers. Could you put me in touch with other San Diego area ZX80 owners so that I could contact them to exchange ideas and questions?

H.S. Wake, San Diego, CA
714/455-1370

To respect your privacy, we will not print subscriber names and numbers, unless you request that your name or number appear.--AZ)

Congratulations on the first issue of SYNTAX ZX80. My ZX80 programs just fit in memory, but there is not enough left to handle variables or display. Machine language programs run faster and use less memory, but I don't grasp the essentials of this method. How about an article or series on machine language? I look forward to future issues of SYNTAX.

Mark Paulkus, New Britain, CT

Coming up.--AZ

HOW TO WIRE A BIG KEYBOARD

Although the ZX80 has many fine features, some people complain about the small pads of the touch keyboard that comes with it. But this is not a serious problem. The ZX80 uses a matrixed keyboard, so you can easily add a bigger, parallel keyboard.

"Matrixed" means each key connects two wires, one for the key row, the other the key column. Sinclair's matrix uses 8 rows and 5 columns which connect to 13 readily available points on the circuit board. Two pins descend from each key: When you depress the key, the pins make electrical contact, connecting an IC pin with the anode of a diode. This tells the computer which key you hit.

When you look for keyboards at electronic surplus houses, try to get these features:

● exchangeable key caps.
● molded block keyboards that come off circuit boards easily.
● caps with changeable legends.
● a circuit board matrix nearly matching the ZX80 matrix.

Unless you're sure you can overcome the problems, avoid these keyboards:

● mechanical types.
● ASCII encoded.
● separate switches on PC board.
● Hall effect keys.
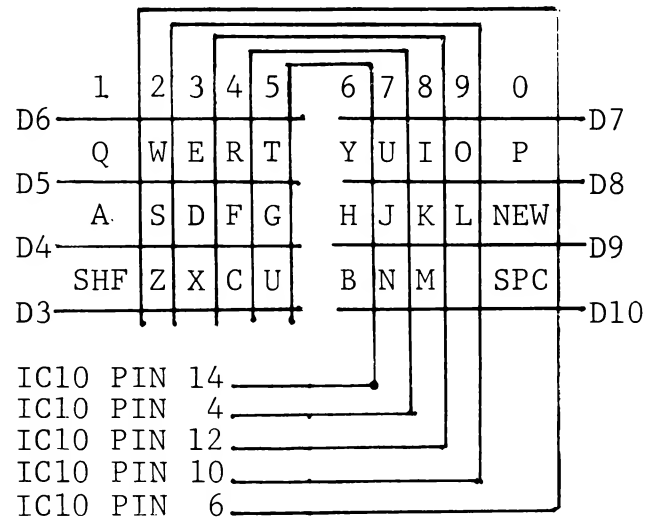● brushes wiping printed contacts.
● capacitive keyboards.

Just wire your big matrixed keyboard in parallel with the existing one. Use standard single-pole, normally open keyswitches. Wire duplicate keys, such as "shift," in parallel so both will function. If your big keyboard has a numeric pad, wire each switch in parallel with the number keys above the letter keys. Use a continuous length of

wire-wrap wire to daisy-chain one contact of each switch in each column. Do the same for the other switch contact in each row. Just push the insulation aside using the stripper of a wire-wrap tool.

All components are clearly labelled on the ZX80 board. You must wire both pins for each key. On the following chart, D3--D10 represent the anodes of the diodes on the front of the PC board. (Look for the diode symbol under the diodes. The anode is at the broad end of the triangle.) Looking at the top of IC10, the pin nearest the IC10 label is pin 1. Pin 16 is directly across from pin 1.

Connect your keyswitches as shown in the following diagram. As shown for key "1", each key connects to the line below it and the line to its right. That is, wire key 1 to diode 6 and to pin 10 of IC10.

```
        1  2  3  4  5    6  7  8  9  0
D6 ─────┐  │  │  │  │    │  │  │  │  │ ───── D7
        Q  W  E  R  T    Y  U  I  O  P
D5 ────────────────────────────────── D8
        A  S  D  F  G    H  J  K  L  NEW
D4 ────────────────────────────────── D9
       SHF Z  X  C  U    B  N  M    SPC
D3 ────────────────────────────────── D10

IC10 PIN 14 _____
IC10 PIN  4 _____
IC10 PIN 12 _____
IC10 PIN 10 _____
IC10 PIN  6 _____
```

For quick removal, use eight spring-loaded test clips for diode connections and parallel IC10 with a 16-pin proto-clip. Ribbon cable makes a good-looking interconnect.

ANSWER TO CRYPTOQUOTE PUZZLE

"Who chooses to compete with machines accepts the conditions of slavery"--Norbert Weiner

SUBROUTINES — SUPER STEP-SAVERS

Last month we talked about FOR-NEXT loops as a way to repeat steps. This time we'll look at subroutines, which tell the computer to repeat a series of steps each time you call them.

Subroutines are mini-programs; they execute a series of steps apart from the main program. In essence, you tell the computer, "Go do those steps and then come back here and proceed with the main program." The ZX80 remembers where it was and returns to the following line after executing the subroutine. You can call the subroutine many times from your main program, but you need type it only once.

Suppose you want to use the TAB subroutine listing on page 17. The subroutine is lines 999-1055, but you need a whole program to fit around it. Say you want to print a list of dollar figures as part of an accounting program you are writing. TAB only helps instruct the computer to display your data in tabular columns. You must still tell what to do with the data you enter. So when you get to line 140, where you want to display results in columns, call up TAB using GO SUB:

```
    :
140 GO SUB 999
    :
```

The computer jumps to 999 and then executes steps until it hits the RETURN command, then hops back to the line after the GO SUB from which it left the main program. When you again want TAB, say at line 290, write:

```
    :
290 GO SUB 999
    :
```

Again, it executes steps 999 to 1055 but this time it returns to the line following 290. TAB uses IF...THEN RETURN statements to jump back. Insert a RETURN at every endpoint of the subroutine.

One more point: As the computer goes through the program steps, it eventually comes to line 999 and tries to carry out the subroutine again. Trouble starts when it prints data you didn't want and then it hits RETURN and has no where to go. The ZX80 gives you an error code 7, meaning it hit a RETURN with no corresponding GO SUB. To avoid this, insert a jump (GO TO) step:

```
900 GO TO 2000
999 REM TAB
    :
1055 GO TO 1030
2000 STOP
```

Now the machine never runs into the subroutine unless directed there by a GO SUB because the GO TO in 900 causes it to jump over the subroutine to the STOP step.

You can GO SUB backwards and forwards — the ZX80 can jump to a subroutine with a larger or smaller line number, so you can insert your subroutine anywhere in your program. Wherever you put it, remember the GO SUB, RETURN and GO TO steps.

Use subroutines whenever you:
● repeat 3 or more program lines.
● reuse a complex line you might mistype.
● want 2 processing steps to always be identical.

NEW MAGAZINE

SYNC, published by Creative Computing, is due to hit the stands in January. Devoted to the Sinclair and MicroAce machines, SYNC will concentrate on software and applications, according to publisher Dave Ahl. Subscriptions are $10 for 6 issues, $15 Canadian and foreign surface. SYNC, 39 E. Hanover Ave., Morris Plains, NJ, 07950 (800) 631-8112.

To SAVE (and therefore LOAD) your programs faster, type CLEAR (NL) before saving. This tells the ZX80 not to save any variables.

BIG CHARACTER PROGRAM

Make your video characters 8 times bigger using ROM character images and substituting graphic symbols for screen dots. Change lines 140 & 160 for other symbols.

```
  5 DIM C(4)
  7 LET K=0
 10 INPUT A$
 11 PRINT
 15 LET K=K+1
 17 IF K<3 THEN GO TO 20
 18 CLS
 19 LET K=1
 20 FOR X=1 to 4
 30 LET C(X)=CODE(A$)
 40 LET A$=TL$(A$)
 50 NEXT X
 60 FOR L=1 TO 8
 70 FOR D=1 TO 4
 80 LET Q=PEEK(C(D)*8+3583+L)
100 LET B=8
110 LET B=B-1
115 IF B<0 THEN GO TO 200
120 IF Q<2**B THEN GO TO 160
130 LET Q=Q-2**B
140 PRINT CHR$(128);
150 GO _ 110
160 PRINT ' ";
170 GO TO 110
200 NEXT D
210 NEXT L
220 GO TO 10
SYNTACTIC SUM = 25918
```

Operation: RUN (NL). Respond to prompt with 4 characters & (NL) for 1st line. Next 4 letters go on 2nd line. Next 4 clear screen before printing on first line. To exit, hit (NL) break.

ZX80 AND MICROACE BUS PINOUT

PIN	BOTTOM	TOP
23	NC	NOT REFSH
22	A4	NOT M1
21	A5	NOT RESET
20	A6	NOT BUSRQ
19	A7	NOT WAIT
18	A8	NOT BUSAK
17	A9	NOT WR
16	A10	NOT RD
15	A11	NOT IORQ
14	A12	NOT MREQ
13	A13	NOT HALT
12	A14	NOT NMI
11	A15	NOT INT
10	A3	D4'
9	A2	D3'
8	A1	D5'
7	A0	D6'
6	NOT CLOCK	D2'
5	0 VOLT	D1'
4	0 VOLT	D0'
3	SLOT	SLOT
2	9 VOLT	RAM CS 1
1	5 VOLT	D7'

Top is component side; bottom, solder side. This is a Z-80 bus.

SYNTAX

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